

Improving Cadastral Accuracy for Disaster Management: The Role of Segment Anything Model (SAM) in Digitizing Historical Cadastral Maps

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Key words: Cadastre; Digital cadastre; Geoinformation/GI; Cadastral maps; Digitization; Segment Anything Model; Land Information System; Disaster Management

SUMMARY

Up-to-date cadastral maps with detailed land ownership, boundaries, and values, are crucial in disaster-prone regions like Nepal, where accurate land data significantly impact disaster risk management for efficient resource allocation, response planning, and so on. Given the challenges associated with updating cadastral mapping, there is a pressing need to digitize existing maps to establish an up-to-date cadastral database. The digitization of old cadastral maps faces challenges like inconsistent skill levels, human errors, and data quality issues, making the process time-consuming and prone to inaccuracies. Hence, automating the process is essential to create an accurate and up-to-date cadastral database.

This study explores the application of the Segment Anything Model (SAM) for automating the digitization of historical cadastral maps, specifically focussing on land parcel boundary extraction, specifically in the context of Nepal. Using a diverse dataset of scanned cadastral maps, the study evaluates SAM's zero-shot segmentation performance under different prompting conditions, including bounding box, multi-point prompts, and their combinations. Key factors such as parcel size, shape, eccentricity, clarity of boundaries, and noise levels of the cadastral map were analyzed. SAM demonstrated promising results, particularly when employing combined prompts, but challenges arose in handling noisy data near parcel boundaries and complex configurations within the parcel. Moreover, false positives between segmented parcels continue to be significant challenges, and increasing the scanning resolution also did not noticeably improve segmentation accuracy.

The study concludes that SAM provides promising solutions for enhancing cadastral digitization in Nepal. The challenges faced highlight the need for integrating Geographic Information Systems (GIS) with SAM, along with human oversight, to ensure the creation of accurate and complete

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cadastral databases. Future research should focus on fine-tuning SAM for one-shot learning or using SAM-2 model and integrating it with diverse remote sensing data to further improve segmentation accuracy and resilience in land administration systems.

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